

### **Remarks**

#### **I. Status of claims**

Claims 1-20 are pending.

Claims 1-11 and 13-20 are rejected.

The Examiner has indicated that claim 12 would be allowable if rewritten in independent form.

#### **II. Claim rejections under 35 U.S.C. § 112**

The Examiner has rejected claims 2, 3, 9, and 20 under 35 U.S.C. § 112, second paragraph, as being indefinite.

##### **A. Claim 2**

The Examiner has not provided any explanation for why he believes that claim 2 is indefinite. For this reason, the Examiner's rejection of claim 2 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

##### **B. Claim 3**

The Examiner has stated that "Claim 3 recites 'wherein both R1 and R2 are at least 99.5%' and claim 1 recites 'wherein R1 and R2 have different respective values one of which is greater than 99.9%' which is conflicting because 99.5% is less than 99.9%."

Contrary to the Examiner's statement, however, there is no conflict between the subject matters recited in claims 1 and 3. Indeed, both R1 and R2 can be at least 99.5% and one of R1 and R2 can be greater than 99.9%. For example, both claim 1 and claim 3 are satisfied when R1 is 99.5% and R2 is 99.99%.

For this reason, the Examiner's rejection of claim 3 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

##### **C. Claims 9 and 20**

Claims 9 and 20 have been amended to address the Examiner's concerns. The Examiner's rejection of these claims under 35 U.S.C. § 112, second paragraph, now should be withdrawn.

### III. Claim rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1-3, 6, 7, 9-11, 13, 15, 16, 18, and 20 under 35 U.S.C. § 102(b) over Wang (U.S. 5,659,568).

#### A. Independent claim 1

Independent claim 1 recites that “the longitudinal stack structure further includes an ion-implanted current confinement region characterized by a peak longitudinal implant concentration separated from the cavity region by a longitudinal distance greater than 0.5  $\mu\text{m}$ .” The Examiner has stated that Wang discloses this feature in col. 9, lines 61-63, and in col. 11, lines 2-7. As explained below, however, Wang does not in fact teach this feature of independent claim 1.

With reference to FIG. 8, Wang teaches in col. 9, lines 61-63, that “Preferably, the proton isolation region ends two to four microns before the sidewalls of the electrode.” In FIG. 8, the ends of the proton isolation regions 320a and 320b are demarcated by the lead lines extending from the distance indicator 801 and the sidewalls of the top electrode are demarcated by the lead lines extending from the distance indicator 802 (see col. 9, lines 23-33). In accordance with Wang's teaching in col. 9, lines 61-63, the proton isolation regions 320a and 320b terminate in the lateral direction 2-4  $\mu\text{m}$  before the respective sidewalls of the top electrodes (i.e., the difference between distance 801 and distance 802 is  $2 \times (2-4 \mu\text{m})$ ). The teachings in col. 9, lines 61-63, have nothing whatsoever to do with the distance separating the peak longitudinal implant concentration of the proton isolation regions 320a and 320b from the quantum well region 316, as proposed by the Examiner.

In col. 11, lines 2-7, Wang discloses that:

The implant step is followed by an undercutting etch step where the second mirror region is etched approximately a distance of greater than two microns. This is followed by an etch of approximately 0.4 microns of the second Bragg mirror region. The etch preferably should remove a portion of the second mirror region without totally removing the proton isolation region.

This disclosure, however, relates to the formation of the multimode VCSEL structure shown in FIG. 6 (see col. 10, line 53 et seq). This disclosure has nothing whatsoever to do with the distance separating the peak longitudinal implant concentration of the proton

isolation regions 320a and 320b from the quantum well region 316 in the multimode VCSEL structure shown in FIG. 8, as proposed by the Examiner.

Thus, none of the cited sections of Wang's disclosure supports the Examiner's statement that the multimode VCSEL structure shown in FIG. 8 "includes an ion-implanted current confinement region characterized by a peak longitudinal implant concentration separated from the cavity region by a longitudinal distance greater than 0.5  $\mu\text{m}$ ." The fact is that Wang does not disclose this feature of independent claim 1.

For at least these reasons, the Examiner's rejection of independent claim 1 under 35 U.S.C. § 102(b) over Wang should be withdrawn.

B. Claims 2, 6, 7, 9-11, and 13

Each of claims 2, 6, 7, 9-11, and 13 incorporates the features of independent claim 1 and therefore is patentable over Wang for at least the same reasons explained above. Claims 6 and 13 also are patentable over Wang for the following additional reasons.

1. Claim 6

Claim 6 recites that "the cavity region without the cavity extension region has a longitudinal optical thickness substantially equal to the operative wavelength."

The Examiner has stated that Wang discloses that "the cavity region without the cavity extension region has a longitudinal optical thickness substantially equal to the operative wavelength" in col. 5, lines 55-64. Col. 5, lines 55-64, however, merely describes the structure of the Bragg mirror regions 302, 308. This section of Wang's disclosure does not teach anything about the longitudinal optical thickness of the quantum well region 316.<sup>1</sup>

The only disclosure in Wang regarding the thickness of the quantum well region 316 is contained in col. 6, lines 43-48. This disclosure, however, does not teach that the quantum well region 316 "has a longitudinal optical thickness substantially equal to the operative wavelength."

For at least these additional reasons, the Examiner's rejection of claim 6 under 35 U.S.C. § 102(b) over Wang should be withdrawn.

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<sup>1</sup> In his rejection of independent claim 1, the Examiner stated that the "cavity region" corresponds to the active region 306, which includes the quantum well region 316 and the cladding layers 314a, 314b, and that the "cavity extension region" corresponds to the cladding regions 314a, 314b. Consequently, "the cavity region without the cavity extension region" must correspond to the quantum well region 316.

2. Claim 13

Claim 13 recites that “the current confinement region defines a current aperture with a diameter of less than 12 micrometers.”

The Examiner has stated that “Wang discloses the diameter of current aperture 336 being larger than that of electrode 322 which is already 10  $\mu\text{m}$  (col. 9, lines 40-44). Col. 9, lines 40-44, recites that:

For the embodiments shown in FIGS. 3 and 6, the electrode 322 is approximately 10  $\mu\text{m}$  in diameter, while electrodes 324 form an opening of approximately 120-150  $\mu\text{m}$ .

Wang teaches that the proton isolation boundary preferably terminates approximately 2 to 4  $\mu\text{m}$  before the sidewalls of the electrodes (see, e.g., col. 8, lines 27-29). In accordance with this teaching, the current aperture 336 would be at least 14  $\mu\text{m}$ , which is not “less than 12 micrometers,” as recited in claim 13. Moreover, this disclosure relates to the multimode VCSEL structures shown in FIGS. 3 and 66, not the multimode VCSEL structure shown in FIG. 8, which is the basis of the Examiner's rejection of claim 13.

The fact is that Wang does not disclose the diameter 801 of the current aperture formed by the proton confinement regions 320a and 320b in the embodiment shown in FIG. 8. One skilled in the art, however, reasonably might infer from Wang's teachings regarding the embodiments shown in FIGS. 3 and 6 that the distance 802 between the sidewalls of the top electrode should be approximately 120-150  $\mu\text{m}$ , in which case the current aperture 801 that is formed by the proton confinement regions 320a and 320b in the embodiment shown in FIG. 8 should be larger than approximately 120-150  $\mu\text{m}$  by  $2 \times (2-4\mu\text{m})$ .

For at least these additional reasons, the Examiner's rejection of claim 13 under 35 U.S.C. § 102(b) over Wang should be withdrawn.

C. Independent claim 15

Independent claim 15 recites features that essentially track the pertinent features discussed above in connection with independent claim 1 and, therefore, is patentable over Wang for at least the same reasons.

D. Claims 16, 18, and 20

Each of claims 16, 18, and 20 incorporates the features of independent claim 15 therefore is patentable over Wang for at least the same reasons explained above.

Claim 18 also is patentable over Wang for the additional reasons explained above in connection with claim 6.

IV. Claim rejections under 35 U.S.C. § 103

A. Independent claim 14

The Examiner has rejected independent claim 14 under 35 U.S.C. § 103(a) over Wang.

Independent claim 14 recites features that essentially track the pertinent features discussed above in connection with independent claim 1 and, therefore, is patentable over Wang for at least the same reasons.

B. Claims 4, 5, 8, and 17-19

The Examiner has rejected claims 4, 5, 8, and 17-19 under 35 U.S.C. § 103(a) over Wang in view of Marrion (U.S. 6,639,928).

Each of claims 4, 5, and 8 incorporates the features of independent claim 1 and each of claims 17-19 incorporates the features of independent claim 15. Marion does not make-up for the failure of Wang to teach or suggest the features of independent claims 1 and 15 discussed above. Therefore, claims 4, 5, 8, and 17-19 are patentable over Wang and Marion for at least the same reasons explained above. These claims also are patentable over Wang and Marion for the following additional reasons.

1. Claim 4

Claim 4 recites that "the cavity extension region has a longitudinal optical thickness greater than twice the operative wavelength."

In his rejection of claim 4, the Examiner has stated that:

Wang discloses the claimed invention except for the thickness of the cavity extension region relative to the operative wavelength of the laser device. Marion discloses an array of lasers including 4 different cavity lengths of 4 different lasers, wherein each cavity length causes the laser to produce a different wavelength. It would have been obvious to the one having ordinary skill in the art at the time the invention was made to provide a cavity extension as taught by Marion to Wang in order to control the output wavelength of the laser.

This reasoning, however, does not establish a proper *prima facie* case of obviousness under 35 U.S.C. § 103(a). In particular, the Examiner has not shown that Marion makes-up

for the failure of Wang to teach or suggest a cavity extension region of the type recited in claim 4 that has a longitudinal optical thickness greater than twice the operative wavelength. Therefore, on its face, the Examiner's rejection of claim 4 does not establish a proper *prima facie* case of obviousness under 35 U.S.C. § 103(a) because it does not include a showing that all the claim limitations are taught or suggested by Wang, Marion, or the knowledge generally available to one of ordinary skill in the art (see MPEP § 706.02(j)).

Moreover, Marion's only teaching regarding the thickness of the cavity extension region relative to the operative wavelength of the laser device is that the wavelength of the emitted laser light depends on the length of the cavity region. Therefore, neither Wang nor Marion teaches or suggests a VCSEL of the type recited in claim 4, in which "the cavity extension region has a longitudinal optical thickness greater than twice the operative wavelength." For this reason, no permissible combination of Wang and Marion possibly could teach or suggest such a feature and the Examiner's rejection of claim 4 under 35 U.S.C. § 103(a) over Wang and Marion should be withdrawn.

2. Claims 5 and 8

Each of claims 5 and 8 incorporates the features of claim 4 and therefore is patentable over Wang and Marion for at least the same reasons explained above.

3. Claim 17

Claim 17 is patentable over Wang and Marion for the additional reasons explained above in connection with claim 4.

3. Claims 18 and 19

Claim 18 is patentable over Wang and Marion for the additional reasons explained above in connection with claim 6.

Claim 19 incorporates the features of claim 18 and therefore is patentable over Wang and Marion for at least the same reasons.

V. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-3718.

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Serial No. : 10/694,290  
Filed : March 17, 2000  
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Attorney's Docket No.: 10031055-1  
Amendment dated Mar. 16, 2006  
Reply to Office action dated Dec. 20, 2005

Respectfully submitted,

Date: March 16, 2006



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